EXHIBIT B

Realizing the Imaginable®

May 17, 1990

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center, MS152D
Hampton, VA 23665-5225

RE: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: April 1989

Dear Mr. Hankins:

During the month of April, effort was directed mainly toward hardware design of the image processing system. The design and fabrication of the wire-wrap prototype has been started. Richard Spille and Nick Busko will be supporting in the fabrication of the wire-wrap prototype demonstration. My efforts will continue with the design and development of the image processing hardware.

The lense reduction element design will be started soon by Dr. Hall at International Computer Robotics, Corp. The specifications for the lense reduction element have been sent to Dr. Hall. He intends to start working on the lense reduction element design toward the end of May with an expected delivery time of one month. We should have a working design near the end of June to incorporate into the camera. Last month I visited the NAB conference in Atlanta, GA to review the latest camera and video technology. I found a lense reduction element very similar to the one Dr. Hall will be providing. However, this element was designed to adapt a Fisheye lense to a 2/3" format camera. It produces a 6 mm circle on a 2/3" format sensor and contains a C-type bayonet mount instead of the F-mount that the Nikon camera uses. Also, I am waiting for more

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information to see if we can use the Nikon lense reduction element for our next design.

Richard Spille has been working on the Fisheye simulation program for the Macintosh. He is currently upgrading the user interface and working on a problem in the way the program handles color images. Once the program has been upgraded, I will send you a copy so that you can run in on one of your Macintosh II's. It will give you an idea of the resolution and quality of the transformation for an NTSC resolution display. Richard will also be providing support with the fabrication of the wire-wrap prototype for demonstration of the hardware. We are currently ordering parts to fabricate the wire-wrap board. I expect to start fabricating the wire-wrap board this month.

We have recently hired Nick Busko as a part-time employee to work with us this summer. His primary responsibility will be to help with the construction of the wire-wrap prototype board. He will be joining us toward the end of May and will be with us until the middle of August. Nick is a senior in Electrical and Computer Engineering at the University of Tennessee, Knoxville and will be graduating in the fall. Nick will also be aiding me in the design of some of the control logic for the image system including PAL logic definition and implementation.

In summary, the main activity over the next few weeks will involve the hardware design of the image transformation processor core and the host controller interface. The Fisheye program is currently being updated to add new features. A wire-wrap prototype is being designed and fabricated for evaluation and demonstration of the hardware.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

Steve Zimmermann

cc:
Mary L. Haywood, MS126
John Samos, MS 139A

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June 14, 1990

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center, MS152D
Hampton, VA 23665-5225

RE: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: May 1990

Dear Mr. Hankins:

The major effort during the month of May involved choosing and purchasing parts for the wire-wrap prototype board. We have received the majority of the breadboard components to start fabricating the wire-wrap board. Nick Busko has been working on the fabrication of the wire-wrap prototype and purchasing the necessary components. The procurement of the fabrication components was scheduled to begin in May with Richard Spille providing full-time support. However, since Richard could not be committed to the project, I decided to seek the assistance of Nick who is a very talented young student from the University of Tennessee and who enjoys being a part of a project effort such as this one. My efforts will continue with the design and development of the image processing hardware.

Nick Busko is currently working on the fabrication of the wire-wrap prototype. He has on order the majority of components needed for construction of the entire prototype. The main components necessary for fabrication are in house with a few components expected within the next week. Nick will be fabricating the host processor logic this week. This should be completed within the next week. The second component that will be constructed is the display controller and output display buffer.

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This will enable display and initial debug of the arbitration logic for the host processor interface. The camera input controller will be fabricated next. This will let us tie the high resolution camera to the system and begin writing software to control the camera and display systems.

Dr. Ernie Hall is currently working on the lense reduction element design. He is scheduled to start the design the first or second week in June. The prototype design should be completed for design review near the end of June. I have tentatively scheduled a visit from Dr. Hall to review the design during the last week of June or first week in July. Also, I am waiting for more information to see if we can use the Nikon lense reduction element for our next design. The second phase will attempt to provide a camera with a 30 frame per second update rate. We will need to investigate the types of cameras available toward the end of summer. Additionally, an alternative to the lense reduction element will be sought in order to minimize the cost of the system.

In summary, the main activity over the next few weeks will involve the hardware design of the image transformation processor core and the fabrication of the wire-wrap prototype. The design of the lense reduction element has been started with a finished version expected for delivery in July. I will be contacting you concerning the Fisheye program that we sent you in the near future.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

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cc:
Mary L. Haywood, MS126
John Samos, MS 139A

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July 16, 1990

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center, MS152D
Hampton, VA 23665-5225

RE: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: June 1990

Dear Mr. Hankins:

The major effort during the month of June involved fabrication and design of the wire-wrap prototype board. The host processor and the output display buffer and memory buffer are completely functional. The camera interface and CCD storage memory buffer are being fabricated this week.

Nick Busko is continuing to work on the fabrication of the wire-wrap prototype. He has on order or has received the majority of components needed for construction of the entire prototype board. During the past month we have built the host processor and interface logic and the video output display buffer and controller logic. The host processor and video output display are completely functional. The display buffer is configured as a 1K by 512 pixel buffer with 8-bit gray scale output resolution. The camera controller and camera input capture buffer are currently being wire-wrapped. Once the input memory buffer is functional, we will be able to display the high resolution camera picture on the output monitor using the host to copy images between the buffers.

Dr. Ernie Hall of ICR Corporation in Cincinnati is currently working on the fabrication of the lense reduction element. Dr. Hall came by this past month for a design review of the lense reduction element. He is currently

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ordering the component parts and lenses to begin fabrication of the lense reduction element. The lense reduction element design uses a three lense configuration to reduce the 180 degree fisheye lense image from its normal 23 mm size to approximately 8.9 mm to fit within the area of the Videk CCD image sensor. The lense reduction element will provide the capability to adjust the size and focus for fine adjustment after mounting on the high resolution camera. I plan to have the first lense reduction element prototype toward the end of next month. At that time we should have the camera connected to the wire-wrap prototype board so that we can display the image on a monitor.

In summary, the main activity over the next few weeks will involve the hardware design of the image transformation processor core and the fabrication of the wire-wrap prototype. The design of the lense reduction element has been started with a finished version expected for delivery in August.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

Steve Zimmermann

cc:
Mary L. Haywood, MS126
John Samos, MS 139A

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August 8, 1990

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center, MS152D
Hampton, VA 23665-5225

RE: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: July 1990

Dear Mr. Hankins:

During the month of July, effort was concentrated on getting the input and output video graphics buffers operational. The development of the wire-wrap prototype is continuing to make progress. The host processor, output graphics display and the camera input capture buffers are finished and are operational. Software is being written to allow controlling of different views and image manipulation using the host processor. The software is being written in FORTH to allow fast debugging and development on the host processor. The camera has an RS-232 interface to a Macintosh system for software development and file storage.

Nick Busko is continuing to work on the fabrication of the wire-wrap prototype. During the past month we have finished the host processor and interface logic, the video output display buffer and controller logic, and the input camera capture buffer and controller logic. The host processor,

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video output display, and camera interface and capture buffer are completely functional. The display buffer is configured as a 1K by 512 pixel buffer with 8-bit gray scale output resolution. The camera controller and camera input capture buffer is configured as 2K horizontal by 1K vertical resolution to capture the entire Videk camera output. The Videk camera generates 1035 vertical by 1320 horizontal active pixels. The host processor is currently being used to translate images from the input capture buffer to the output display for viewing in real-time. The host processor can provide continuous image capture to the input buffer from the Videk camera or it can allow for single frame and frame by frame capture of the image. The host processor can also read and write to both memories providing support for diagnostic functions and testing of different lenses. I am using the fisheye lense and the 55mm lense that were supplied with the Videk camera for testing of the resolution and the quality of the image. The output from the Videk camera is high quality and looks very sharp with the 55mm lense. The fisheye lense at present provides about a 60 degree viewing angle. It will provide a 180 degree viewing angle when we add the lense reduction.

Dr. Ernie Hall of ICR Corporation in Cincinnati is currently working on the fabrication of the first pass of the lense reduction element. The lense elements are lense holders for the reduction element have been ordered and are scheduled to be delivered this month. The lense reduction element mechanical components are currently being fabricated. The prototype hardware design currently will allow the input camera image to be copied to the output buffer and displayed on the output display monitor so that the lense reduction element design can be verified for correct image registration and focusing.

I am currently investigating different cameras and processor architectures for use in the next pass of the design. Last week I visited a JVC distributor to view a 1K by 1K resolution 2/3" format camera. The camera used Saticon tubes rather than CCD with an update rate of 0.4 seconds or 2.5 Hz. The output format was in RGB, however, giving a 24 bit

color image so that the image output was very high quality. The JVC camera has an interface to allow it to be connected to the NuVista frame capture and graphics board for high resolution image capture. I would like to design for color and real-time update if time and budget permit. However, the present design will provide a very good quality gray-scale image output. I have not finalized a decision on the camera control host processor. I am still looking at the Motorola DSP56000 architecture or the newer DSP96000 floating point processor. I will be making a final choice on the host processor to be used after the prototype board is completely functional.

In summary, the main activity over the next few weeks will involve the hardware design of the image transformation processor core and continuing with the fabrication of the wire-wrap prototype. The design of the lense reduction element has been started with a finished version expected for delivery in August. The lense reduction element will be tested at TRI on the prototype board.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

Steve Zimmermann

cc:
Mary L. Haywood, MS126
John Samos, MS 139A

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September 14, 1990

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center, MS152D
Hampton, VA 23665-5225

RE: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: August 1990

Dear Walter:

The major effort during the month of August was to finish the wire-wrap of the camera interface, image capture buffer and the output display buffer as well as write the control software to control the Videk camera. These components are completely functional and are working reliability. The Videk camera interface works very well. We are able to control the exposure rate and to lock on the camera scan rate using a video system controller and control logic to capture the 1320 by 1024 resolution image. The frame rate of the camera can be controlled up to a maximum of about 7 frames per second at the 10 MHz pixel scan rate. The remainder of the task is to finish the wire-wrapping of the image processor core logic.

Nick Busko is continuing to work on the fabrication of the wire-wrap prototype. The design of the major components of the image processing core are now finished and are being incorporated into the wire-wrap prototype. There are four main blocks of the image processor that have to be wire-wrapped — the image processing core, the interpolator logic, the raster scan generator, and the vector generator. The design of these components are completed except for the programmable control logic that ties all of the major blocks together. The programmable logic consists of

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programmable state machine control and sequencer logic. The design of the sequencer logic is being worked on at present.

Dr. Ernie Hall of ICR Corporation visited TeleRobotics International for a design review of the prototype of the lense reduction element. The prototype board was functional so that we could obtain a full image. The lense reduction element uses three elements to obtain a 1/3 reduction of the fisheye image. We were not able to get a satisfactory image with the fisheye lense attached to the Videk camera using the lense reduction element. Dr. Hall is going to investigate the lense arrangement for other design alternatives. A single lense version may be possible that increases the light throughput more than the first approach. I will be communicating with D. Hall over the next week to try to determine a better approach.

In summary, the main activity over the next few weeks will involve the fabrication of the wire-wrap prototype and programming the sequencer and state machine control logic. A first pass of the lense reduction element was finished and tested. The design is being investigated for improvements in image quality and light level transmission.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

Steve Zimmermann

cc:
Mary L. Haywood, MS126
John Samos, MS 139A

Realizing the Imaginable®

October 11, 1990

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center, MS152D
Hampton, VA 23665-5225

RE: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: September 1990

Dear Walter:

The design of the major components of the image processing core are now finished and are being incorporated into the wire-wrap prototype. There are four main blocks of the image processor that have to be wire-wrapped - the image processing core, the interpolator logic, the raster scan generator, and the vector generator. The design of these components are completed except for the programmable control logic that ties all of the major blocks together. In this past month, we have concentrated effort on finishing the wire-wrap fabrication for the majority of the design. This has been accomplished with the image processing components and the interfaces completely wire-wrapped. The effort at present is focused on programming the control logic and testing each component of the design separately. At this time, only three of the control PALs remain to be designed and programmed. I am currently working on the approach and design of these PALs and expect to be finished within the next week.

Dr. Ernie Hall visited last month to test the first pass of the lense reduction element. The first attempt was unsuccessful and we were not able to obtain a satisfactory image with our camera system. Dr. Hall has since then reviewed the design and found an error in the lense design equations. The current approach will be to use a two lense approach at the

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expense of a longer lense reduction element. The advantage to this approach will be a higher level of light throughput to the sensor and a less distorted image since. Dr. Hall is scheduled to visit within the next week to test the second approach or our Videk camera system. He has been very positive concerning the test results and believes the second approach will be successful. The lense reduction design approach we are taking should let us easily redesign for other types of high resolution cameras.

I have spent some of the design time working on a second version of the project plan with Dan Kuban. Dan has recently hired on with TRI to try to provide support with company project planning and following costs. We are working on an overall project plan to show past as well as present activities and man-power requirements. This will continue to take considerable time and effort over the near future.

In summary, the main activity over the next few weeks will involve the programming of the image processor control logic and testing of the sire-wrap board design. A second pass of the lense reduction element is almost finished and will be tested shortly. Some time and effort are being used to work on an overall project plan.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

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Mary L. Haywood, MS126
John Samos, MS 139A

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November 12, 1990

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center, MS152D
Hampton, VA 23665-5225

RE: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: October 1990

Dear Walter:

The design of the electronics system for the prototype fisheye camera is completely finished. We are currently working on the wire-wrap board and are adding components and testing the functionality of each block. The wire-wrap board was completely finished as of last month. However, an error was found in the wiring of the large 121-pin components. The model generated for these components was wrong so the past couple of weeks have been spent rewiring the board. There are four main blocks of the image processor that have to be tested - the image processing core, the interpolator logic, the raster scan generator, and the vector generator. In this past month, we have concentrated effort on finishing the wire-wrap fabrication for the majority of the design. This has been accomplished with the image processing components and the interfaces completely wire-wrapped. The effort at present is focused on programming the control logic and testing each component of the design separately. The first pass of the design of each of the programmable logic components is finished and is being tested on the board. The main task for completion of the prototype system and demonstration at NASA is completion of the testing of each of the major blocks. Software is being written to configure each of the blocks as testing is completed.

The Videk camera failed on us last month. The camera failed to produce digitized video and has been sent back to Videk for repairs. I am expecting to receive the camera within the next two weeks. Videk says that their repair department has fairly quick turn around., Our efforts on finishing the prototype board will be delayed slightly until we get the camera back. I don't expect the impact on the testing of the prototype to be severe since a majority of the electronics can be tested for functionality without the camera.

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On October 29 Dr. Ernie Hall of International Computer Robotics (ICR) delivered a new version of the image reduction optics. This version was a big improvement over the first , but still was not satisfactory. The image was not focused, was slightly too large, and appeared to have excessive aberration. The new version still uses a three lens system, but now all are 22.4 mm diameter. The new version has also been black anodized, and had light stops added to minimize the amount of light scattered from the sides. Dr. Hall also has some higher quality lenses that will be substituted after testing at TRI. Unfortunately the Videk camera failure has delayed this testing. We have also been investigating a commercial image converter from Nikon for use as an image reduction system. This converter is very close to the optical requirements, but uses a different mechanical mount.

I found another possible solution for the lense reduction element. Nikon makes an F-mount to Bayonet-mount reduction element that adapts a 35-mm Nikon lense to the 2/3" format cameras. This would allow a fisheye lense to be attached to the camera. Since our camera already has the F-mount format we can not use the adapter directly. However, because the Bayonet type 2/3" cameras have longer focal length than standard C-mount cameras, we may be able to make it work by using a simple extension ring and modifying the Videk camera and adding a Bayonet-mount in place of the F-mount. We are trying to get a loaner from Nikon for testing. The major disadvantage of using the adapter would be that the size of the circle is fixed and is smaller than Videk camera image sensor so we would loose some resolution in both the horizontal and vertical. This may not be a problem for cameras that meet the 2/3" format and use higher density CCD arrays. I am still searching for a better approach for a commercial implementation of the fisheye camera.

In summary, the main activity at present involves testing the wire-wrap prototype board. The design has been finished and we are currently testing each of the major blocks and adding components to the board as the testing progresses. A second pass of the lense reduction element was finished and tested. Dr. Hall is currently working on another version of the reduction element. The camera has been sent back for repairs.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

Steve Zimmermann

cc:
Mary L. Haywood, MS126
John Samos, MS 139A

Realizing the Imaginable®

December 18, 1990

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center, MS152D
Hampton, VA 23665-5225

RE: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: November 1990

Dear Walter:

The prototype wire-wrap camera system has now been finished. The wire-wrapping was completed last month. All of the components have been installed on the board and thoroughly tested. At the present, software is being written to incorporate the algorithm and fully test the hardware. So far I have been able to produce rotated and scaled images with different degrees of warping and the response of the system looks very good. I plan to have the full algorithm implemented within the next 2 weeks for a full demonstration. We are currently having a box fabricated to house the electronics so that it will be easily portable. I am looking forward to sharing the results with you on my visit to Langley next month.

I have added a high precision arithmetic package to the host processor to support the 48-bit precision arithmetic for the image processing computer. The host processor now recognizes 48-bit number such as 3.14159265359. The inclusion of the decimal point tells the host to convert the number to extended precision. Also, multiplies and divides support 96-bit intermediate results. This has proved to be extremely useful in testing the system and in software development. The desire for the first pass of the software is to provide the capability to simply send the direction of view in degrees and the amount of zoom or rotation and have the host processor calculate the results for the algorithm coefficients. This will make the interface very simple so that it can be controlled from any host over a serial communication link.

The Videk camera was sent out for repairs last month. The sensor unit needed to be replaced and was covered under the manufacturers warranty. The reason for failure was not determined. I have noticed that the camera is very static sensitive. The

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camera body is kept grounded when in use now to try to prevent failure from static discharge.

Since last month, I have received two new image reduction elements from Dr. Hall for testing with the system. The first one, mentioned in last month's report, produced too large an image and was very fuzzy. It was shipped back to Dr. Hall for new lenses and received again for testing. Although the image size is nearly correct, the image reduction element still produces a very fuzzy image. The image produces a 180 degree field of view but is still unusable as it is. I have since found a possible replacement adapter manufactured by Nikon. Nikon makes an F-mount to Bayonet-mount reduction element that adapts a 35-mm Nikon lense to the 2/3" format cameras. This would allow a fisheye lense to be attached to the camera. Since our camera already has the F-mount format we can not use the adapter directly. I have persuaded Nikon to provide the unit for evaluation and we are in the process of having an adaptor made to allow the Nikon adapter to be mounted to the Videk camera. This should be ready for testing before the end of the week. The major disadvantage of using the adapter will be that the size of the circle is fixed and is smaller than the Videk camera image sensor so we would loose some resolution in both the horizontal and vertical. This may not be a problem for cameras that meet the 2/3" format and use higher density CCD arrays. I am still searching for a better approach for a commercial implementation of the fisheye camera. The resolution of the circular fisheye image using the Nikon adapter with the Videk camera will be approximately 900 by 900 pixels. This is only 50% of the possible resolution when using the full 1320 horizontal dimension for the image size.

In summary, the main activity at present involves testing the wire-wrap prototype board and developing software to operate the image processing hardware. The design has been finished and the wire-wrap board has been extensively tested. A second and third pass of the lense reduction element was finished and tested. A mount is being fabricated to incorporate the Nikon adapter to the Videk camera for use in early demonstrations.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

Steve Zimmermann

cc:
Mary L. Haywood, MS 126
John Samos, MS 139A

Realizing the Imaginable®

January 18, 1991

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center, MS152D
Hampton, VA 23665-5225

RE: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: December 1990

Dear Walter:

Most of last month was spent debugging the prototype hardware and testing the electronics. The prototype wire-wrap board was packaged in an enclosure so that it could be transported easily. External connectors were mounted on the box for connection to the camera, monitor, host computer, and ac power.

The prototype electronics is working quite well. I am using it extensively to determine goals for the second design phase of the project. Some of the desired goals were left out of the first prototype design to allow testing of the concept and architecture. I am using a lower clock rate then the image processors and hardware can operate to match the scan rate of the Videk camera and the access speed of the video RAM memory. This was done also since the prototype was wire-wrapped on a large board using fairly long lengths for signal busses. The Videk camera scan rate is around 5Hz with a 10 MHz pixel rate. I am currently addressing the memory buffers at about 1 MHz. The image processing hardware can potentially be operated at 20-40 MHz. A memory bandwidth of about 8 MHz is needed to provide a 2x2 filtered image at 30 Hz with NTSC output resolution. The maximum bandwidth of the current memory architecture of the prototype board is about 2 MHz using 120 nS Video memory. These will be addressed in the next phase of the design. I am currently looking at new video memory and video ram controllers that provide higher bandwidth.

Some more software was written to support the arithmetic capabilities of the host processor. Sin/Cos and Tangent were added using a 9 decimal lookup table for integer degrees from -32768 to 32767. The 48-bit/96-bit arithmetic software has proven useful in programming and testing the image processors and hardware. I plan to have the host computer send only the direction and angle of the image via RS-232

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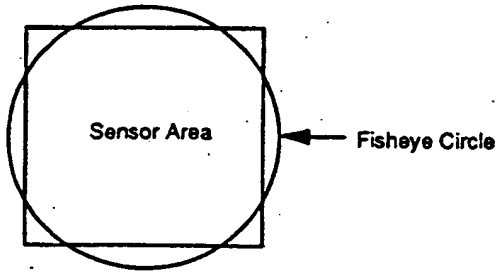
serial communications while the host processor on the prototype board calculates all necessary coefficients. A user interface has been started on the Macintosh to provide the camera interface and control, however, the prototype and finished design will be controllable from any host computer with serial communications.

The camera optics remains as the only serious impediment to reaching the goals of the project. The major challange is finding a fisheye image and high resolution camera match in either black-and-white or color. The major problem is that the fisheye lense produces a 23 mm diameter circle for 35 mm format cameras with a Nikon F-mount. I have obtained an evaluation unit of an adapter the reduces the size of the fisheye image to about 6 mm but this is too small for the high resolution cameras on the market. Also, the light levels are significantly reduced and dispersion is more pronounced. One possible solution is the new 2Kx2K sensor that Kodak has recently released. The new sensor has dimensions of 19x20 mm. This provides a diagonal measurement of 27.6 mm providing much higher resolution that the current solution and nearly matches the image size of the fisheye image.



In summary, the main activity at present involves testing the wire-wrap prototype board and developing software to operate the image processing hardware. The design has been finished and the wire-wrap board has been extensively tested. A Nikon image reduction adapter was tested with the Videk camera. The fisheye and adapter only produce about a 880 pixel diameter image. Software is being written to provide image manipulation and testing.

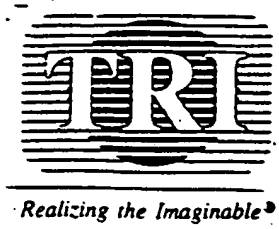
Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

Steve Zimmermann

cc:
Mary L. Haywood, MS126
John Samos, MS 139A



April 15, 1991

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center
MS152D
Hampton, VA 23665-5225

Subject: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: March 1991

Dear Walter:

The design of the second version of the Fisheye camera system is still progressing. I am busy searching for components to improve the interface capability and enhance the overall system. I am currently considering the purchase of an Actel development system. This will provide the capability to incorporate the miscellaneous glue logic into one or two field-programmable-gate-array devices. The Actel devices have 3000 and 6000 gate equivalents. Other hardware components that will undergo design improvement are the VRAM image buffer interfaces and the 2-D convolution image filter section. Considerations are being made to support both black-and-white and color cameras. These considerations will affect the size of the image memory interface and the filtering architecture. Also, consideration is being made on the host processor. I am considering using the Motorola 68340 processor or 68332 for the host. These processor have the 68020 core but include peripheral control circuitry for real-time control applications.

The software to drive the fisheye camera system and the image transform electronics was modified so that it could be completely ROMed. The first pass of the ROM was finished this past week. The system will now auto-boot without the need for the Macintosh system. It provides joystick control using the dual-joystick hand-held controller that was fabricated last month. The hand-held controller has two joysticks and four pots. The joysticks provide pan-tilt control of the direction of view. Two dual-

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position switches on the unit provide mode change inputs. At present, the system provides the capability to have either a single 400x400 pixel display or two 256x256 NTSC resolution displays. When in the dual display mode, each joystick controls an image allowing pan-and-tilt operation.

The patent application was revised to include comments from our patent attorney. The second pass was submitted to the patent attorney for his review.

We are currently searching vendors for different camera systems and lenses to meet the second phase design goals. I am continuing to search for possibilities for the next camera. The 2Kx2K sensor is still extremely expensive. I have received a JVC camera that has a C-mount and a wide angle < 110° to interface to the prototype system. The JVC camera has a black-and-white RS-170 interlaced output. This will provide testing for the input genlock circuitry that I intend to incorporate on the final version.

In summary, the main activity at present involves software development using the wire-wrap prototype system. The user interface for controlling the multiple views and demonstration of the system has been enhanced so that the camera can be controlled using a remote hand-held unit. The patent application is being reviewed by a local patent lawyer. A search for different camera and lense combinations is ongoing. Also, the redesign of the second version of the camera system is progressing.

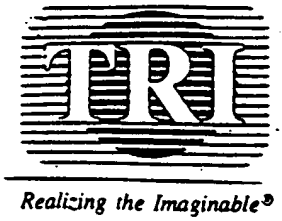
Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

Steve Zimmermann

cc:
Mary L. Haywood, MS126
John Samos, MS 139A



May 14, 1991

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center
MS152D
Hampton, VA 23665-5225

Subject: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: April 1991

Dear Walter:

The design of the second version of the Fisheye camera system is still progressing. I am busy searching for components to improve the interface capability and enhance the overall system. I have purchased and received an Actel field-programmable-gate-array development system. This package provides the capability to consolidate much of the miscellaneous logic into the higher density FPGA parts. Targeted designs will include logic for the vector raster scan block, the barrel shifters, interface logic, and the pipeline control logic. I have just started to learn the Actel development system so that I can begin to partition the design. Other hardware components that will undergo design improvement are the VRAM image buffer interfaces and the 2-D convolution image filter section. The architecture of the core image processor system will not change in the new design. I am trying to improve the interfaces by using the FPGAs so that I can insure real-time frame rate transformations. As far as the input memory is concerned, the input image frame capture will support 2K x 2K images. This will allow connection to the Kodak image sensor when the cameras become available.

We are currently applying for the no cost extension to extend the project till the end of the year. The project schedule was updated to reflect the remainder of the task. I am including a copy for your information. We are expecting to deliver a working system the end of the year. The final report and documentation will follow the first part of next year.

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The patent application was revised to include comments from our patent attorney. The second pass was submitted to the patent attorney for his review last month. The patent information was reviewed and sent off to the patent office last week.

In summary, the main activity at present involves redesign of the image processor board. The patent application has been sent to the patent office for filing. An FPGA design system has been purchased for the next phase of the design. A search for different camera and lense combinations is ongoing.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

Steve Zimmermann

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Mary L. Haywood, MS126
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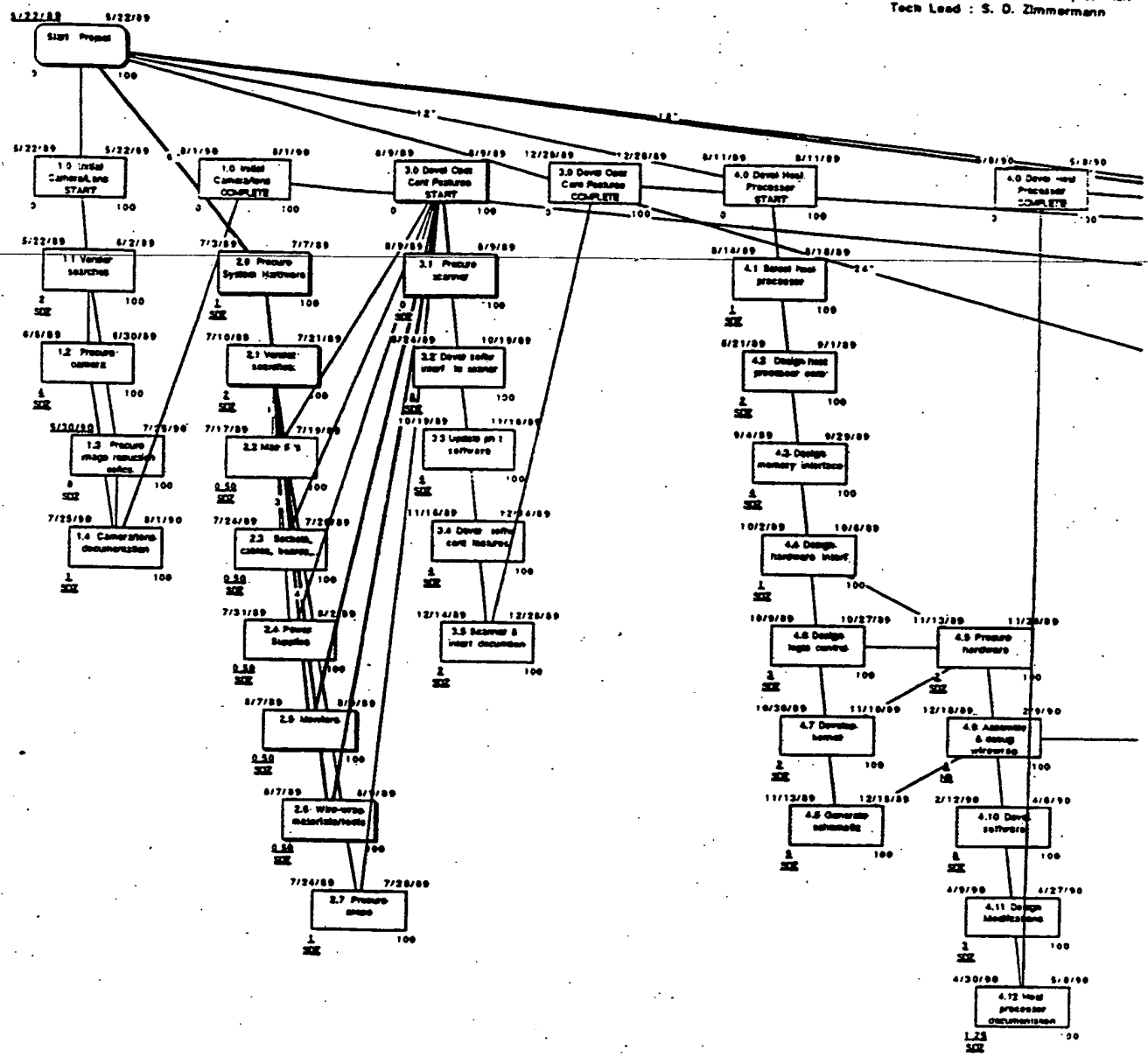
NASA Fisheye Camera Project Plan
Tech Lead : S. D. Zimmermann



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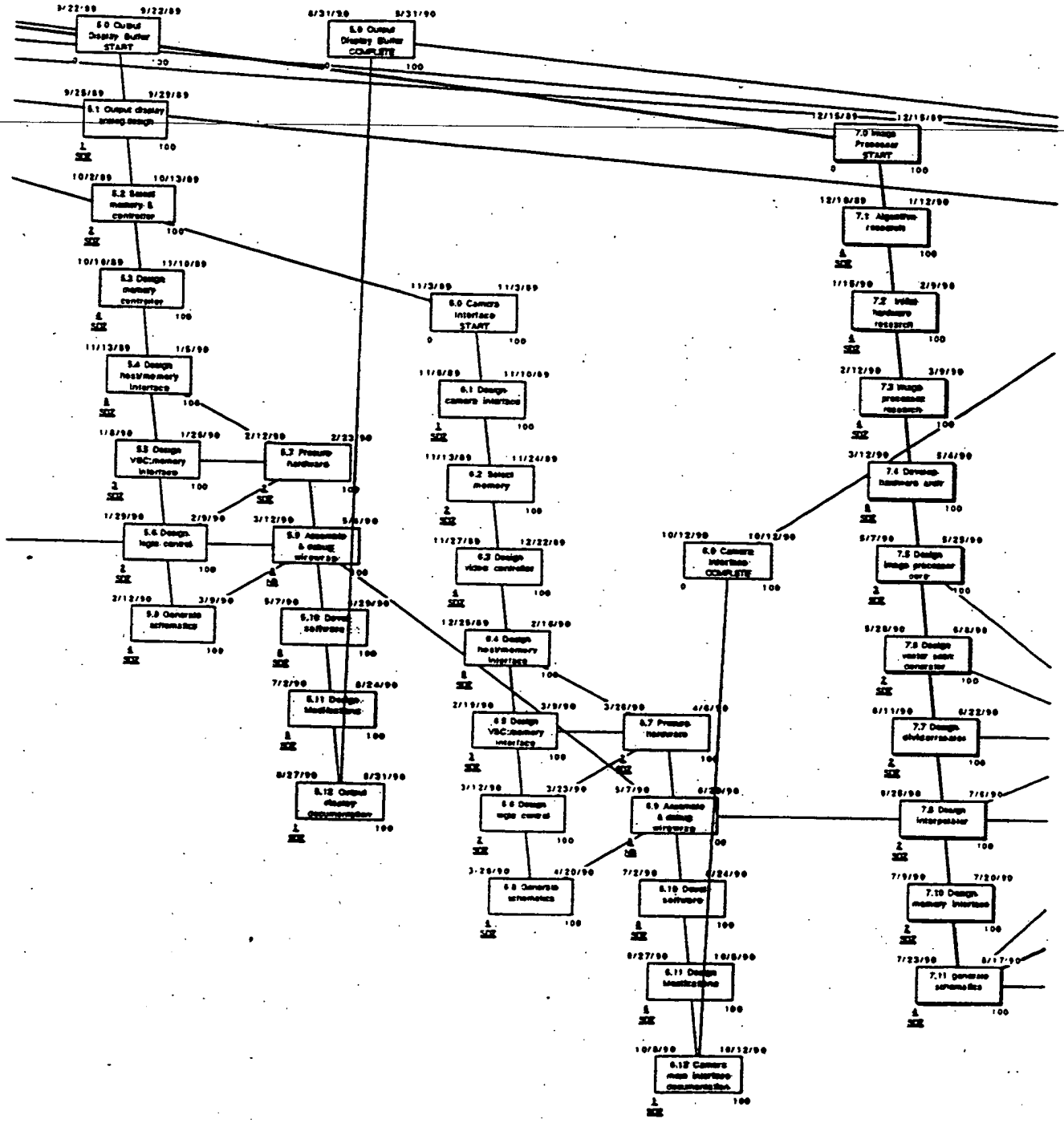
Rev 2 April 30, 1991

PROTOTYPE PHASE



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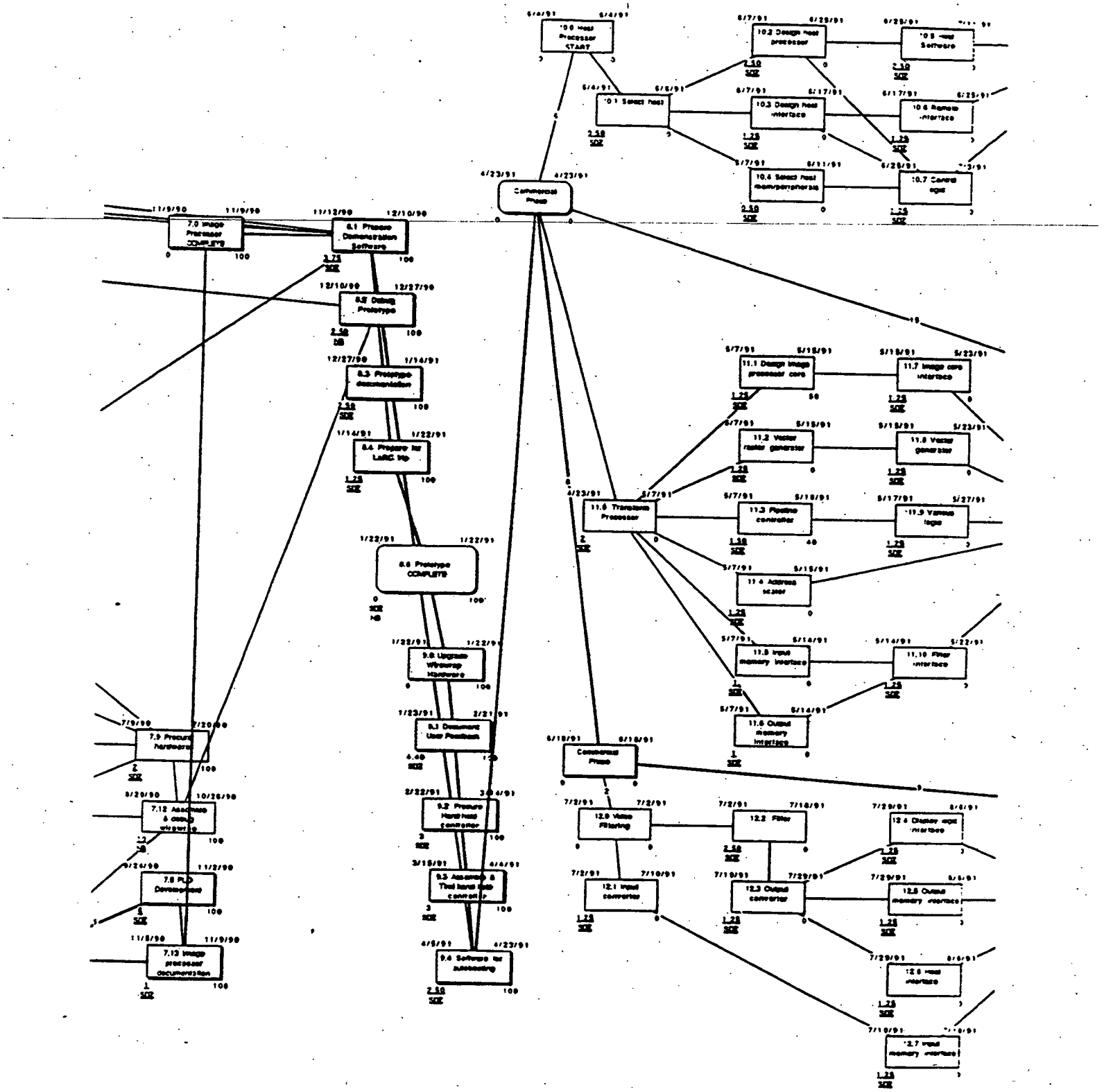

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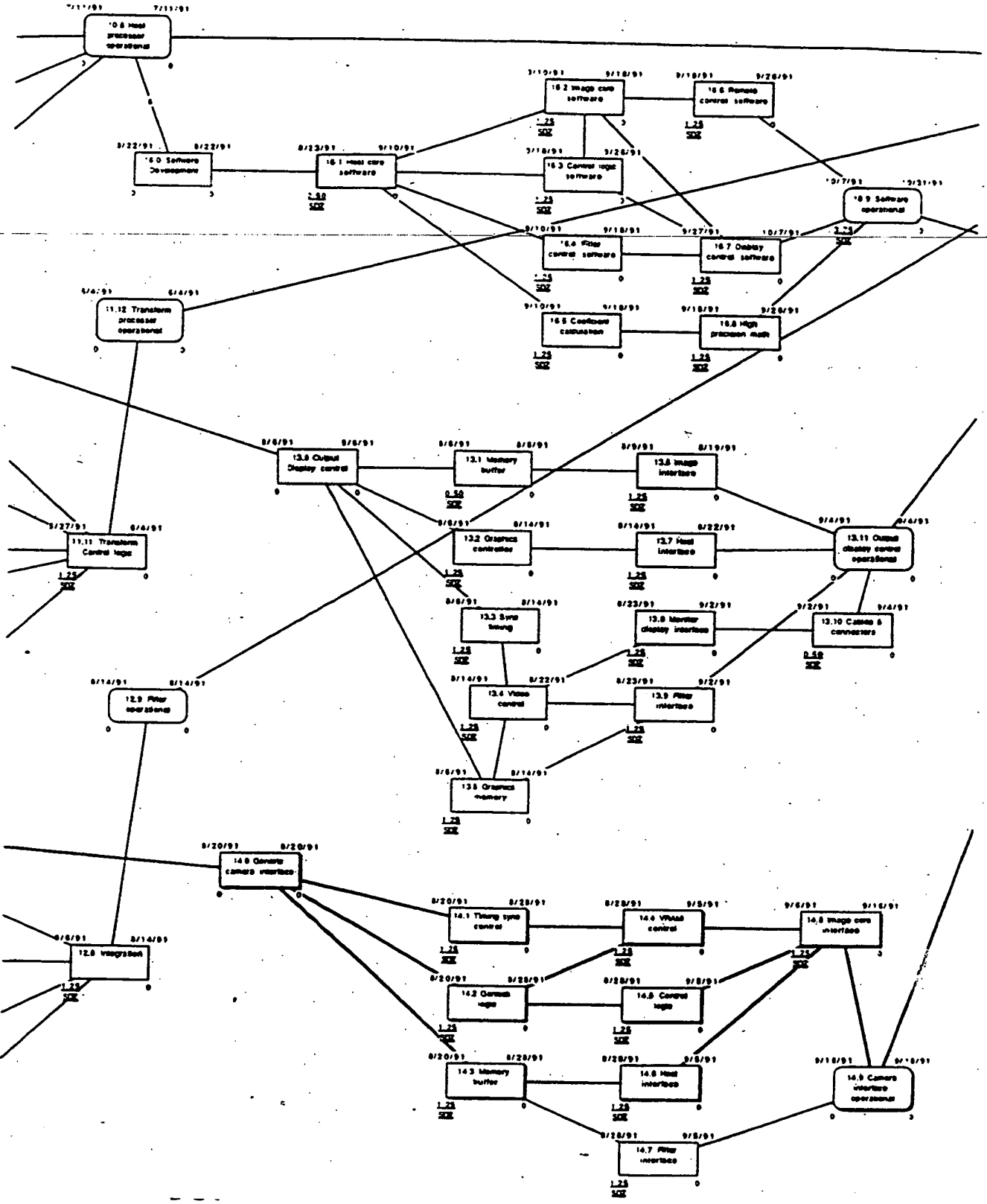

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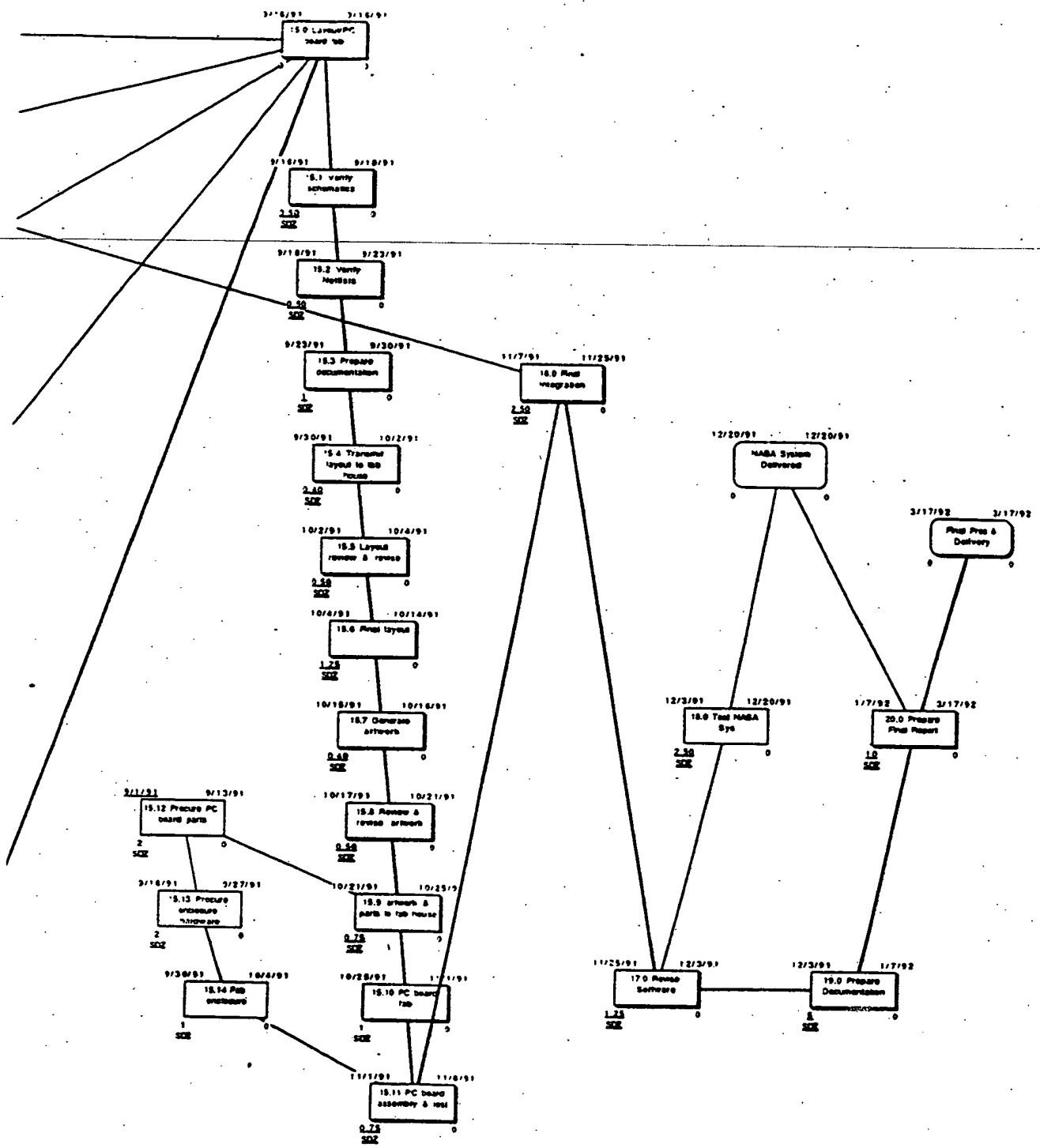
15.0 Layout PC board lab
15.1 Verify schematics
15.2 Verify Netlists
15.3 Prepare documentation
15.4 Transmit layout to lab house
15.5 Layout review & revise
15.6 Final layout
15.7 Generate artwork
15.8 Review & revise artwork
15.9 artwork & parts to lab house
15.10 PC board fab
15.11 PC board assembly & test
15.12 Procure PC board parts
15.13 Procure enclosure hardware
15.14 Fab enclosure
16.0 Final integration
17.0 Revise Software
18.0 Test NASA Sys
19.0 Prepare Documentation
20.0 Prepare Final Report
NASA System Delivered
Final Pres & Delivery

Realizing the Imaginable®

June 12, 1991

Mr. Walter Hankins, Technical Representative
NASA Langley Research Center
MS152D
Hampton, VA 23665-5225

Subject: Monthly report
Contract NAS1-18855
Electro-Optical Pan/Tilt/Zoom

Period: May 1991

Dear Walter:

The design of the second version of the Fisheye camera system is still progressing. I am busy searching for components to improve the interface capability and enhance the overall system. As mentioned last month, I have purchased an Actel field programmable gate array development system. This package provides the capability to consolidate much of the miscellaneous logic into the higher density FPGA parts. Targeted designs include logic for the vector raster scan block, the barrel shifters, interface logic, and the pipeline control logic. I am designing the raster scan generators and the video ram memory buffer interfaces. The raster scan designs will provide a good indication of the speed and flexibility of the Actel gate array components. Other areas of effort are the design of the video interfaces.

In summary, the main activity at present involves redesign of the image processor board. The raster scan logic design is being incorporated into an Actel gate array. A search for different camera and lense combinations is ongoing.

Please call me at 615-690-5600 if you have any questions or comments.

Sincerely,

Steve Zimmermann

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